Lucent Technologies (formerly AT&T Bell Laboratories)

Reusable Software for Computing Networks

In the mid-1990s, a new type of business telephone network was evolving: the computing network. A computing network was an integration of software and "intelligent devices" that used their own software. Thus, on one network, a user could process voice, faxes, and video; moreover, the network also had speech recognition capability. This idea interested product line managers at telecommunications companies, and they began to design new software products for the versatile computing network.

Through its Bell Laboratories research arm, AT&T, a leader in telephone service and research, wanted to design a software tool that nonprogrammers could use to build their own computing networks to handle incoming voice, fax, and other data traffic. After a successful implementation in the small and home office environment, AT&T predicted that the software could be scaled to larger businesses. This technology was risky due to variables that had to work together seamlessly in order to operate successfully. AT&T wanted to mitigate the technical risk for research in the highly competitive, deregulated telecommunications industry, so the company applied for Advanced Technology Program (ATP) funding and received an award under the 1994 "Component-Based Software" focused program.

Their product, called Symphony, successfully demonstrated the basic functions required for a do-it-yourself network. Then, while development was still underway, AT&T spun off the technology to Lucent Technologies, which continued the research. In July 1997, several months before the ATP-funded project ended, Lucent acquired Octel Communications, which had already developed a product that accomplished the same tasks as Symphony. Lucent discontinued work on Symphony in favor of promoting the Octel product line, which it later spun off to Avaya. Avaya still sells Octel products, which do not appear to incorporate the Symphony technology.

COMPOSITE PERFORMANCE SCORE
(based on a four star rating)

No Stars

Research and data for Status Report 94-06-0011 were collected during July – August 2004.

Business Telecommunications Evolve from Voice Only

In the 1990s, the business telecommunications industry was facing a new challenge in its evolution: the emergence of computing networks. A computing network is a group of phone lines and other devices, such as fax machines and personal computers (PCs), that are interconnected on a network. Complex software, both on the network and in the individual devices, drives each step of the phone voice or data message transmissions. Telecommunications companies such as AT&T, a major provider of local and long-distance telephone service, wanted to win market share in the emerging computing networks arena. Many companies were vying for a share of the computing network market, and the competition to enter this new market was stiff. The software necessary to oversee and manage a computing network was enormously complicated and expensive to develop. At that time, AT&T was feeling its way through the computing network's new business opportunities created by a Federal consent decree that resulted in the deregulation of the telephone business. This decree opened to competition services that formerly had been solely AT&T's. In this highly competitive climate, AT&T applied for and received ATP funding for a two-year project under the 1994 "Component-Based Software"

focused program. AT&T proposed to develop a software system to enable a nonprogrammer to build and customize a reliable computing network to manage business phone calls. The first market for this software would be the small office/home office environment. Later, AT&T hoped to enhance the software so that it could handle the network computing needs of larger businesses.

AT&T Considered Computing Network Complexities

Designing software to process calls on a computing network was challenging; the more services offered on a call, or on the network transporting the call, the more complicated the software and its updates must be. For example, if a network offers voice command capability, that feature adds a layer of complexity because the voice recognition software component must properly recognize the commands. In the mid-1990s, these capabilities were not available to small businesses, because of the complexity of developing custom applications for each business. The more complicated the network software becomes, the more functions need to be simultaneously monitored by the software's highest level function in order to prevent or fix call processing that can go awry in the transmission process. The software must have a high degree of fault-tolerance, which is the ability for the software to guess, if necessary, which step to take after the previous step is completed. This might be necessary due to conflicts resulting when many devices, each with its own unique software, are interconnected on a network.

Tool Needed to Build a Customized Computing Network

AT&T wanted to design reusable software that a nonprogrammer could use to build a customized, fault-tolerant computing network for small businesses. If successful, this software would reduce the high cost of updating and maintaining the call-processing software. The foundation of the software would be "building blocks" that the user would employ to assemble a customized computing network that consisted of only the functions the user needed. An example of one of these building blocks is an announcement that would play when the called party was not available. This was and still is a common component in a typical phone-messaging system. The building blocks would reside in a library that the user could access through a PC graphical user interface (GUI) in order to build the customized network. Because the reusable software library had hundreds of building blocks, networks ranging from simple to complex could be built. AT&T named its proposed software "Symphony," after the idea that all the pieces of the software would work together to perform a function, just as the musical instruments in an orchestra play together to perform one composition.

Symphony Would Deliver New Call-Handling Features

Ideally, AT&T wanted to design the Symphony software architecture with call-handling features that could be achieved without frequent software or hardware upgrades. The following were the desired call-handling features:

- Programmability, which is the ability to modify or update functions
- Reliability, including fault tolerance, which is a necessary characteristic of any computing network
- Interoperability, which is the capacity to interface with other software and hardware
- Scalability, which is the ability to easily increase line or message capacity
- Low cost, which would make the software affordable for small businesses and home offices

Building a system with these features was daunting, because complex software-governed networks were inherently prone to unpredictable bugs, because of the frequent updates required to accommodate new functionality and new technology. The greater the complexity of the software, the greater the potential for bugs. In the mid-1990s, computing networks were not capable of delivering the five features that AT&T identified. Nor were the traditional voice networks able to deliver this enhanced functionality; their services were limited to the basic calling services of call answer, call hold, call transfer, and conference-calling. The traditional voice networks did, however, offer a better

quality of service for the basic calling services than the emerging computing networks were able to offer.

AT&T Collaborates to Test Symphony

During its development work on Symphony, AT&T teamed with the Center for Reliable and High Performance Computing, a division of the computer science department at the University of Illinois in Champaign-Urbana. Several computer science graduate students tested versions of Symphony with the university's simulation software called "Depend." Depend could simulate stresses that Symphony would encounter, such as a high number of calls or the failure of critical system components. The developers from the university and AT&T used Depend to test Symphony through many cycles of iterative modeling, analysis, prototyping, and revision. By the end of the ATP-funded project's first year, AT&T had completed the initial architecture and had performed a demonstration of a very simple computing network. The researchers also used Depend to successfully test the following technical challenges:

- Connection failure detection, or how long it would take Symphony to sense that a call has accidentally disconnected due to a software or hardware failure
- Connection recovery time, or how long it would take a system to reconnect an accidentally disconnected call due to a software or hardware failure
- Connection reconfiguration time, or how long it would take the software to find an alternative route to reconnect an accidentally disconnected call

Corporate Restructuring Causes Change of Focus

Following the first demonstration of Symphony, AT&T worked on issues related to more complex versions of Symphony. They made progress toward a stable complex build, but an AT&T corporate restructuring interrupted development. In order to enable AT&T to compete in the newly deregulated long-distance market, the Symphony development group was spun off into Lucent Technologies in 1996. After the spin-off, Symphony, in its original form, never regained its momentum, partly due to staff losses and transfers associated with the restructuring.

Lucent Attempts Viper Development

To regain Symphony's product development momentum that was hobbled by AT&T's restructuring, Lucent attempted in 1997, the last project year, to develop a simpler messaging product for the computing network environment called "Viper." Viper was based on the Symphony software design and worked under Microsoft Windows. This product was intended for an emerging market: the high-availability, low-cost, small-office systems for voice and Internet data communication. Although Viper was originally slated for delivery in the first quarter of 1998, it was canceled in late 1997 when Lucent acquired Octel Communications. Octel was a provider of voice, fax, and electronic messaging technologies and already had a phone-messaging product called Octel Messaging Systems, which had a solid customer base, and was similar to Symphony.

The software necessary to oversee and manage a computing network was enormously complicated and expensive to develop.

After acquiring Octel, Lucent made attempts to integrate Symphony, or parts of its design, into other ongoing product development efforts. For example, two Lucent clients needed speech-recognition circuitry for their business solutions, which was one of Symphony's functions. However, developers were unable to integrate this capability. Consequently, Lucent decided to discontinue developing Symphony, because most of its functions were already available in the Octel Messaging Systems. In 2000, Lucent spun off the Octel messaging product line to Avaya, which still sells Octel messaging products. It is unlikely that any of Symphony's functionality was integrated into Octel's product line.

Despite the discontinuation of Symphony, Lucent software developers gained a better understanding of modular (building-block) software architecture for dependable telecommunication services. They achieved some success with reusable software components on a Microsoft Windows platform, with minimal customization to the building-block architecture. Lucent also published 11 articles and papers resulting from company or industry forums and conferences.

Conclusion

In the mid-1990s, the computing network in the business environment was evolving rapidly, along with the capabilities, costs, services, and architecture of business telephones and personal computers (PCs). With these advancements came needs to control and enhance the capabilities of the devices on those networks. AT&T, a dominant telephone service provider, proposed to develop, through its Bell Laboratories, a technology that would reduce the costs of upgrading and maintaining computing networks. Their proposed software tool would use reusable software building blocks, which provided an easy-to-use tool for nonprogrammers.

The product, called Symphony, targeted the small office and home office environment. Although AT&T successfully demonstrated the product at the end of the first year of the project, Symphony was not developed further because of AT&T's corporate restructuring in 1996. The technology was transferred to Lucent Technologies, a company spun off during the restructuring. Shortly after this transfer, Lucent acquired Octel Communications, which already had a viable voice-messaging product. Octel products were later spun off to Avaya in 2000. Even though Symphony was never fully developed, software developers gained a greater knowledge of modular (building-block) software design and published 11 papers and professional journal articles.

PROJECT HIGHLIGHTS
Lucent Technologies (formerly AT&T Bell Laboratories)

Project Title: Reusable Software for Computing Networks

Project: To develop an easy-to-use, graphics-user interface (GUI) software assembly system that allows nonprogrammers to build reliable, custom-designed software by using libraries of reusable software components.

Duration: 2/15/1995–12/31/1997
ATP Number: 94-06-0011

Funding (in thousands):**

ATP Final Cost	$1,711	46%
Participant Final Cost	1,973	54%
Total	$3,684	

Accomplishments: AT&T was able to develop and successfully demonstrate their software, Symphony. Moreover, AT&T (part of which was later acquired by Lucent) gained a better understanding of modular software architecture for dependable telecommunications services.

Commercialization Status: No commercialization resulted from this project. Lucent obtained a product similar to Symphony when it acquired Octel Communications. Consequently, Lucent decided to discontinue its development of the reusable software component product Symphony.

Outlook: The outlook for this technology is weak. Many competing companies offer similar technologies and levels of phone-messaging services.

Composite Performance Score: No Stars

Focused Program: Component-Based Software, 1994

Company:
AT&T Bell Laboratories
2000 North Naperville Road
Naperville, IL 60566

Contact: Alexander B. Dadson
Phone: (908) 582-5495

Publications:

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** As of December 9, 1997, large single applicant firms are required to pay 60% of all ATP project costs. Prior to this date, single applicant firms, regardless of size, were required to pay indirect costs.

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